

WHAT IS CLAIMED IS:

1. A device for removing an occlusion from within the central lumen of a tubular structure, the device comprising:

a proximal end, a distal end and an intermediate segment between the proximal end and the distal end;

an occlusion removing structure having a low profile configuration and having a high profile configuration, the occlusion removing structure comprising a proximal end, a distal end and an intermediate segment between the proximal end and the distal end, and comprising an outer diameter.

2. The device of claim 1, where the occlusion removing structure comprises an extension of the intermediate segment;

where the occlusion removing structure further comprises one or more than one foldable disc mounted transversely on the extension; and where converting the device from the low profile configuration to the high profile configuration comprises unfolding the one or more than one disc;

where the device further comprises a sheath comprising a proximal end, a distal end, and a central lumen;

where the sheath surrounds the intermediate segment of the occlusion removing structure; and

where the sheath is axially movable with respect to the occlusion removing structure.

3. The device of claim 2, where the one or more than one foldable disc is a plurality of discs.

4. The device of claim 3, where at least one of the plurality of discs has a diameter different from another of the plurality of discs.

5. The device of claim 2, where the one or more than one foldable disc is at least three discs; and where the distance between two adjacent discs is different from the distance between two different adjacent discs.

6. The device of claim 2, where each disc comprises silicone.

7. The device of claim 1, where the device further comprises a sheath comprising a proximal end, a distal end, and a central lumen;

where the sheath is axially movable with respect to the occlusion removing structure.

where the distal end of the occlusion removing structure comprises a self-expanding portion;

where the sheath functions to compress the self-expanding portion within the central lumen of the sheath; and

5 where converting the device from the low profile configuration to the high profile configuration comprises relieving the compression on the self-expanding portion.

8. The device of claim 7, where the distal end of the sheath further comprises a flaring distal collar configured to permit the self-expanding portion of the distal end of the device to be retracted into the central lumen of the sheath.

10 9. The device of claim 2 or claim 7, further comprising a removable tab surrounding the intermediate segment of the occlusion removing structure, immediately distal to the proximal end of the device, where the tab prevents extrusion of the distal end of the occlusion removing structure from the distal end of the sheath.

10 10. The device of claim 2 or claim 7, where the sheath comprises a proximal collar configured to prevent the proximal end of the occlusion removing structure from entering the central lumen of the sheath.

11. The device of claim 2 or claim 7, where the occlusion removing structure further comprises a mechanism for applying axial force to the distal end of the occlusion removing structure.

20 12. The device of claim 2 or claim 7, further comprising an enclosure bag comprising a proximal end, a distal end and an intermediate segment, where the intermediate segment of the enclosure bag comprises a tube of material capable of being reversibly compressed and extended axially.

25 13. The device of claim 1, where the distal end of the occlusion removing structure comprises an inflatable balloon, and where converting the device from the low profile configuration to the high profile configuration comprises inflating the balloon; and

where the device further comprises an enclosure bag comprising a proximal end, a distal end and an intermediate segment, where the intermediate segment of the enclosure bag comprises a tube of material capable of being reversibly compressed and extended axially.

30 14. The device of claim 1, where the device has a long axis;
where the distal end of the occlusion removing structure comprises an expandable

wire basket, and where converting the device from the low profile configuration to the high profile configuration comprises activating a mechanism, thereby transmitting axial force to contract the wire basket in a distal to proximal direction, and thereby expanding the wire basket in a direction perpendicular to the axis of the device; and

5 where the device further comprises an enclosure bag comprising a proximal end, a distal end and an intermediate segment, where the intermediate segment of the enclosure bag comprises a tube of material capable of being reversibly compressed and extended axially.

15 15. The device of claim 12 or claim 13 or claim 14, where the intermediate segment of the enclosure bag comprises a substantially transparent material.

10 16. The device of claim 12 or claim 13 or claim 14, where the proximal end of the enclosure bag comprises a proximal end piece comprising an axial lumen having a diameter greater than the outer diameter of the occlusion removing structure.

15 17. The device of claim 12 or claim 13 or claim 14, where the distal end of the enclosure bag comprises a distal end piece comprising an axial lumen having a diameter greater than the outer diameter of the occlusion removing structure.

18. The device of claim 12 or claim 13 or claim 14, where the distal end of the enclosure bag comprises a connector for mating with the proximal end of the tubular structure with an occlusion.

20 19. The device of claim 17, where the connector is a "Christmas Tree" type connector or is a Luer-lock type connector.

20 20. The device of claim 12 or claim 13 or claim 14, where the enclosure bag further comprises a removable cover.

21. The device of claim 2 or claim 7 or claim 13 or claim 14, where the proximal end of the device further comprises a connector.

25 22. The device of claim 2 or claim 7 or claim 13 or claim 14, where the occlusion removing structure comprises an extension of the intermediate segment, and where the extension comprises a blunted tip at the distal end of the occlusion removing structure.

30 23. A method for removing an occlusion from a tubular structure, where the tubular structure comprises a proximal end, a distal end, and intermediate segment and a central lumen within the intermediate segment, and where the occlusion is within the central lumen, the method comprising:

a) providing means for removing an occlusion from within the central lumen of a tubular structure, where the means for removing an occlusion comprises a proximal end and a distal end, and comprises an occlusion removing structure having a low profile configuration and having a high profile configuration;

5 b) inserting the distal end of the means for removing an occlusion into the proximal end of the tubular structure in the low profile configuration;

c) advancing the means for removing an occlusion through the central lumen of the tubular structure until the distal end of the means for removing an occlusion is at least partly distal to the occluding material;

10 d) converting the occlusion removing structure into the high profile configuration; and

e) withdrawing the means for removing an occlusion from the tubular structure while the occlusion removing structure is in the high profile configuration, thereby removing some or all of the occluding material from the tubular structure.

15 24. The method of claim 23, where the means for removing an occlusion comprises one or more than one foldable disc, and where converting the occlusion removing structure into the high profile configuration comprises unfolding the one or more than one foldable disc;

20 25. The method of claim 23, where the means for removing an occlusion comprises a self-expanding portion, and where converting the occlusion removing structure into the high profile configuration comprises relieving compressive force on the self-expanding portion.

26. The method of claim 24 or claim 25, where the means for removing an occlusion comprises an enclosure bag; and

withdrawing the means for removing an occlusion causes the occluding material to deposit within the enclosure bag.

25 27. The method of claim 23, where the means for removing an occlusion comprises an inflatable balloon;

where converting the occlusion removing structure into the high profile configuration comprises inflating the inflatable balloon;

where the means for removing an occlusion comprises an enclosure bag; and

30 withdrawing the means for removing an occlusion causes the occluding material to deposit within the enclosure bag.

28. The method of claim 23, where the means for removing an occlusion comprises a wire basket;

where converting the occlusion removing structure into the high profile configuration comprises activating a mechanism to transmit axial force to contract a wire basket in a distal to proximal direction thereby expanding the wire basket;

where the means for removing an occlusion comprises an enclosure bag; and

withdrawing the means for removing an occlusion causes the occluding material to deposit within the enclosure bag.

29. The method of claim 23, comprising repeating steps b) through e).

30. The method of claim 23, where the means for removing an occlusion is a first means for removing an occlusion, and where the method further comprises performing the steps b) through e) with a second means for removing an occlusion, where the first means for removing an occlusion and the second means for removing an occlusion comprise different mechanisms for converting the occlusion removing structure from the low profile configuration to the high profile configuration.

31. The method of claim 23, where the tubular structure comprises a connector on the proximal end, and where the method further comprises connecting the means for removing an occlusion to the connector.

32. A method for removing an occlusion from a tubular structure, where the tubular structure comprises a proximal end, a distal end, an intermediate segment and a central lumen within the intermediate segment, and where the occlusion is within the central lumen, the method comprising:

a) providing a device according to claim 2 or claim 7;

b) inserting the distal end of the device into the proximal end of the tubular structure in the low profile configuration;

c) advancing the device through the central lumen of the tubular structure until the distal end of the device is at least partly distal to the occluding material;

d) converting the occlusion removing structure into the high profile configuration; and

e) withdrawing the device from the tubular structure while the occlusion removing structure is in the high profile configuration, thereby removing some or all of the occluding material from the tubular structure.

33. The method of claim 32, where the device comprises an enclosure bag, and withdrawing the device causes the occluding material to deposit within the enclosure bag.

34. The method of claim 32, where the device further comprises a removable tab; and

5 where the method further comprises removing the tab from the intermediate segment, thereby permitting the distal end of the occlusion removing structure to extrude through the distal end of the sheath.

10 35. A method for removing an occlusion from a tubular structure, where the tubular structure comprises a proximal end, a distal end, an intermediate segment and a central lumen within the intermediate segment, and where the occlusion is within the central lumen, the method comprising:

a) providing a device according to claim 13 or claim 14;

b) inserting the distal end of the device into the proximal end of the tubular structure in the low profile configuration;

15 c) advancing the device through the central lumen of the tubular structure until the distal end of the device is at least partly distal to the occluding material;

d) converting the occlusion removing structure into the high profile configuration; and

20 e) withdrawing the device from the tubular structure while the occlusion removing structure is in the high profile configuration, thereby removing some or all of the occluding material from the tubular structure.

36. The method of claim 35, where withdrawing the device causes the occluding material to deposit within the enclosure bag.

37. The method of claim 32 or claim 35, comprising repeating steps b) through e).

25 38. The method of claim 32 or claim 35, where the device is a first device, and where the method further comprises performing the steps b) through e) with a second device, where the first device and the second device comprise different mechanisms for converting the occlusion removing structure from the low profile configuration to the high profile configuration.

30 39. The method of claim 32 or claim 35, where the tubular structure comprises a connector on the proximal end, and where the method further comprises connecting the device to the connector.

40. The method of claim 39, where the method further comprises unconnecting the connector from the device after removing the occluding material.